PACIFIC HERRING STOCKS AND FISHERIES IN THE ARCTIC-YUKON-KUSKOKWIM REGION OF THE BERING SEA, ALASKA, 2003 AND OUTLOOK FOR 2004

By

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INTRODUCTION

The objectives of this report are to summarize the results of the 2003 Pacific herring stock assessment programs for the Arctic-Yukon-Kuskokwim Region (AYK), review 2003 management strategies and harvests in all AYK commercial and subsistence herring fisheries, and present harvest projections and general management strategies for the 2004 fishing season. The commercial fishing districts addressed in this report are: Security Cove, Goodnews Bay, Cape Avinof, Nelson Island, Nunivak Island, Cape Romanzof, Norton Sound, and Port Clarence (Figures 1 and 2).

The Alaska Board of Fisheries established threshold biomass levels for all districts with the exception of the Port Clarence District. When the herring biomass for specific districts are below threshold levels commercial harvests are not to be allowed. Commercial exploitation rates are limited to a maximum of 20% in all areas. In the Nelson Island and Cape Avinof Districts, the Board of Fisheries has further restricted exploitation rates to protect subsistence harvests. All AYK herring districts open and close by emergency order authority. The Nelson Island, Nunivak Island, Cape Romanzof, and Norton Sound herring fisheries were designated limited entry status in 1987. A moratorium to new entry was placed on the Goodnews Bay herring fishery starting in 1997. In Norton Sound, two spawn-on-kelp fisheries are allowed, an open pound spawn-on-kelp fishery, and a wild spawn-on-kelp fishery. In the Nunivak Island District, a cooperative purse seine fishery was established beginning in 2000. In addition, all AYK commercial herring districts, except Security Cove and Port Clarence, are designated as superexclusive use areas.

A total biomass of 70,627 tons of herring was estimated to have been present in the surveyed portion, excluding Port Clarence, of the AYK herring districts in 2003 (Tables 1 and 2). The biomass distribution by district is presented in Figure 3. The 2003 return was above the 5-year average (1998-2002) of 62,781 tons. The combined biomass of all districts was comprised of 2.9% recruit herring (age 5 or less), 70.2% middle-aged herring (ages 6-8) and 26.9% older herring (ages 9 and older). Ages 6 and 7 were the dominant age groups in all AYK districts comprising 63.9 % of the biomass. In numbers of fish, the percentage of recruits (age 5 or less) was 5.4%, the lowest recruitment percentage ever recorded in the AYK.

The 2003 herring harvest for the AYK was 2,945 tons (Tables 2 and 3), below the most recent 5-year average of 5,674 tons, and was the second smallest harvest since 1994. The harvest distribution by district is presented in Figure 4. Most of the harvest was sold as sac roe product, except for 21 tons sold as bait in the Norton Sound District (Table 2). No waste herring was reported. The 2003 total exploitation rate for the AYK was 4.2% (Table 2), the lowest rate since 1994. Exploitation rates, in areas with a commercial fishery, ranged from 0.4% in Goodnews Bay District to 16% in Nelson Island District (Table 2). The Security Cove District did not have a commercial fishery in 2003.

Poor market conditions have focused the need for a high-quality product. Fisheries in the northeast Bering Sea are also the last fisheries to occur and fisheries occurring further south, for the most part, have satisfied market needs. Roe recoveries in the sac roe harvest ranged from 8.4% in the Nunivak Island District to 10.9 % in the Cape Romanzof District (Table 2). The combined roe recovery for the AYK is 9.8%.

The 2003 estimated exvessel value for the AYK was $461,000, well below the most recent 5-year average (1998-2002) of $1,059,400. The value of the Region's commercial herring fishery has declined dramatically since the high value years of 1996 (Table 2), with the decline having been the most pronounced since 2001. The decline is likely attributable to the combination of the poor market value of herring and increasing fuel prices which have resulted in fishers seeking other available employment opportunities in the area. In 2003, the price paid to fishers inseason varied through out the region, including incentives, ranged from $150 per ton for 11% roe content in the Norton Sound Area to $200 per ton for 11% in the Kuskokwim Area. These prices do not include post season adjustments made by the buyer or local Community Develop Quota Groups. This is compared to $200 per ton in 2000 and $200 to $500 per ton in 1999.

A total of 150 permit holders participated in AYK sac roe herring fisheries during the 2003 season, 120 in the gillnet fisheries, 29 in the Nunivak Island purse seine cooperative, and 1 in the Norton Sound *Macrocystis* kelp fishery (Table 4). Participation decreased in all districts except Goodnews Bay when compared to 2002. The number of AYK herring fishers participating in 2003 was well below the most recent 5-year average (1998-2002) of 400 fishers, and the lowest since the fishery developed in the late 1970s. In the Norton Sound District, one permit holder participated in the open pound spawn-on-kelp fishery. In the Security Cove District, no fishers participated. In general, permit holders participating in the Security Cove fishery come from the Togiak District once that fishery concludes. In recent years, the Togiak District fishery has typically finished prior to the opening of the commercial fishery in the Security Cove District. In 2003, the Togiak District fishery overlapped with the peak spawning activity in Security Cove District. As a result, there was no interest from the fishers or buyers in the fishery.

Biomass projections are made for each district using postseason escapement estimates, historical mean rates of survival, current mean weights for each age class, and assumed recruitment rates for each age class (Wespestad 1982). The projected 2004 spawning biomass of the northeastern Bering Sea herring stocks (Security Cove to Norton Sound) is 62,922 tons, with an allowable commercial harvest of 12,381 tons (Table 5). The 2004 projected biomass is 89% of the observed 2003 biomass of 70,627 tons (Table 2).

Variability in survival rates and aerial survey assessments of biomass and deviations from the assumed survival or recruitment rates may result in the observed biomass being either above or below the biomass projection. As an example, observed biomass estimates may be greater than expected if there are large numbers of recruit herring in 2004. Harvest levels may be adjusted inseason according to observed herring spawning biomass. If aerial survey methods cannot be used to determine herring abundance, stock abundance will be assessed using information from the projected biomass, test and commercial catches, and spawn deposition observations. In accordance with the AYK harvest strategy, the commercial fishery will not target newly recruited age classes.

STOCK STATUS

Assessment Methods

The timing of the spawning migration of herring in the northeastern Bering Sea is influenced by climate and oceanic conditions, particularly the extent and distribution of the Bering Sea ice pack. Most herring appear soon after ice breakup, which generally occurs between late-April and mid-June. Spawning usually begins in the Security Cove District and progresses in a northerly direction. In some areas, spawning may continue into July. In most AYK districts the spring spawning migration timing appeared to be early in 2003. The timing of the herring runs in the Kuskokwim Area in 2003 were among the earliest on record based on historical commercial harvests and spawning timing documentation. The early arrival of herring into the Kuskokwim Area may have been the result of abnormally warm climatic conditions in southwestern Alaska during the winter of 2002-2003. Also, water temperatures in the Bering Sea during March and April were above average, and the Bering Sea ice pack had migrated north of Cape Newenham by the end of March.

Aerial survey techniques have been used since 1978 in the Bering Sea herring fisheries to estimate herring spawning biomass (Lebida and Whitmore 1985). However, biomass estimates from aerial surveys in the AYK are often difficult to obtain because of poor survey conditions caused by unfavorable weather, ice conditions, or turbid water. Herring school surface areas are recorded in 538 ft^2 relative abundance index (RAI) units. In the AYK, RAI units are converted to biomass based on water depth. Because purse seine gear is needed to estimate the conversion factors and purse seine gear use is limited in the AYK, conversion factors developed in the Togiak District were used. Ground surveys are conducted in some districts to obtain information on the distribution and density of kelp beds and herring spawn deposition.

During 2003, 71 aerial surveys totaling 58.9 hours of flight time were flown in the AYK Region: 2 (1.3 hours) in Security Cove, 3 (2.4 hours) in Goodnews Bay, 0 in Cape Avinof, 5 (1.9 hours) in Nelson Island, 3 (2.4 hours) in Nunivak Island, 0 in Jacksmith Bay, 1 (0.5 hours) in Cape Romanzof, 13 (33.1 hours) in Norton Sound, and 0 in Port Clarence. Poor weather conditions limited the number of surveys flown in the Kuskokwim Area in 2003.

Gillnets are the only legal gear in the majority of the AYK, with the exception of Norton Sound where a portion of the harvest is normally taken using beach seine gear and Nunivak Island where a cooperative purse seine fishery is allowed. Additionally, Norton Sound recently established an open pound spawn-on-kelp fishery and a wild spawn-on-kelp fishery.

Herring from variable mesh gillnet[1] (VMG) catches and commercial catches were sampled to estimate age, sex, size, and sexual maturity, and to note the occurrence of other schooling fishes in the Goodnews Bay, Nelson Island, Cape Romanzof, and Norton Sound Districts. Commercial samples only were collected in the Nunivak Island and Cape Avinof Districts. VMG samples only were collected from the Security Cove District. An attempt was made to sample at least 420 herring from each commercial gear type, district or subdistrict per week. The sampling goal for department

[1] The floating variable-mesh gillnet (VMG) is 100 ft (31 m) in length and 10 ft (3 m) in depth and consists of four 25 ft (8 m) panels with stretch mesh sizes of 1.5, 2.0, 2.5, and 3.0 inches (38, 51, 64, and 76 mm).

test fish catches was to sample a minimum of 60 herring per day or 420 per week from each district or subdistrict captured using VMG. A total of 8,911 herring from commercial gillnet, subsistence and VMG test catches were sampled during the 2003 season. Age composition for Nunivak Island and Cape Avinof was estimated using samples from Nelson Island and Security Cove, respectively. In most districts, fishers, in cooperation with the Department, provided catch samples for roe quality evaluation by industry representatives. Participation by fishers in collecting samples, processor evaluation of samples, and the flexibility of fishers to fish on short notice helped to increase roe recoveries.

Spawning Populations

Security Cove District

Since 1981, biomass estimates in the Security Cove District have ranged from 2,300 tons in 1987 to 8,267 tons in 1981 (Table 1). The projected herring biomass for 2003 was 4,590 tons. Two aerial surveys were flown in the district (May 2 and May 3) to estimate herring biomass and observe spawning activity. Both surveys were flown under acceptable conditions. The largest biomass, 10,600 tons, was observed on May 2. Two spawns, for a total of 3 miles were observed in the district.

The Department's test fish crew sampled 1,020 herring caught with VMG. Ages 6 and 7 comprised almost 68% of the samples. Recruit herring, ages 2-5 represented 3.4% of the returning population (Figure 5). A summary of the age composition of the returning population is found in Figure 6.

Goodnews Bay District

Since 1980, biomass estimates in the Goodnews Bay District have ranged from 1,213 tons in 1980 to 6,896 tons in 1999 (Table 1). The herring biomass projected to return to this district in 2003 was 5,186 tons. Two acceptable aerial surveys were flown over the district one each on May 2 and May 3. The May 2 aerial survey documented 8,300 tons of herring biomass and one spawn for 0.25 miles in length. The survey conditions were rated as fair. The observed biomass exceeded the preseason biomass estimate of 5,186 tons. As a result, the 2003 guideline harvest was increased to 1,700 tons. A second survey on May 3 observed 2,600 tons of herring biomass and one spawn less than one mile in length. Four other attempts to fly surveys were made between May 4 and May 9. Poor weather and poor survey conditions resulted in unacceptable surveys.

The Department's test fish crew sampled 1,614 herring caught with VMG. Recruit herring, ages 2-5, represented 4% of the returning population (Figure 5). Ages 6 and 7 dominated the return in numbers of fish (31.8% and 33.9%, respectively). A summary of the age composition of the returning population is found in Figure 6.

Cape Avinof District

Since 1985, biomass estimates in the Cape Avinof District have ranged from 1,225 tons in 1987 to 4,600 tons in 1997 (Table 1). The herring biomass projected to return to this district in 2003 was 3,812 tons. The district consists of shallow mud flats where turbidity, caused by wind and wave action, often limits visibility. The last year in which the herring biomass was estimated by survey was 1992, when 3,446 tons were observed. In other years, the preseason projection or commercial harvest rates have been used to estimate herring biomass. No acceptable surveys of the Cape Avinof District were flown in 2003. Aerial survey conditions in this district are typically classified as poor because of turbid water conditions. The estimated total returning biomass was based on the preseason projection of 3,800 tons.

Test fishing with VMG was not conducted by the Department in Cape Avinof because of a lack of funding. Since 2003 was the first year VMG samples were not collected in Cape Avinof; another area's VMG samples had to be used as a surrogate. In order to determine which area's age composition most closely matched Cape Avinof's, the 2002 percent age compositions by number of fish for Nelson Island, Goodnews Bay, Security Cove were compared to Cape Avinof. Security Cove's VMG samples were determined to be the best fit and were used to estimate Cape Avinof's age class composition for 2003 (Figure 7).

Recruit herring represented 3.6% of the spawning population (Figure 5). Ages 6 and 7 herring dominated the biomass (Figure 6) and the return in numbers of fish. Age 9 and older herring comprised 20% of the biomass.

Nelson Island District

Since 1985, biomass estimates in the Nelson Island District have ranged from 2,385 tons in 1991 to 9,500 tons in 1985 (Table 1). The herring biomass projected to return to this district in 2003 was 5,120 tons. Five aerial surveys were flown over the district between May 14 and May 21. Survey conditions were rated as poor to unsatisfactory. The peak observed herring biomass of 1,450 tons was documented on May 21 under poor to unsatisfactory survey conditions. Five spawns for a combined 6 miles in length were observed during aerial surveys of the district. The management strategy for the Nelson Island district is to prosecute the commercial fishery once a threshold biomass of 3,000 tons is observed. In the absence of aerial surveys under acceptable conditions, the commercial fishery was prosecuted after spawning was observed and the guideline harvest was based on the preseason biomass estimate.

The Department's test fish crew sampled 1,676 herring caught with VMG. Recruit herring, ages 2-5, represented 8.5% of the returning population (Figure 5). Ages 6 and 7 dominated the return in numbers of fish (41.6% and 22.9%, respectively). A summary of the age composition of the returning population is found in Figure 6.

Nunivak Island District

Since 1985, biomass estimates in the Nunivak Island District have ranged from 422 tons in 1990 to 6,000 tons in 1986 (Table 1). The herring biomass projected to return to this district in 2003 was 5,182 tons. Five aerial surveys were flown in the Nunivak Island District between May 15 and June 2, 2002. Survey conditions ranged from fair to unsatisfactory. The peak observed herring biomass of 5,038 tons was documented on May 15 under fair to poor survey conditions. Three spawns of approximately 2 miles in length were observed during aerial surveys of the district.

Test fishing with VMG was not conducted by the Department in the Nunivak Island District because of a lack of funding. Age composition of the Nunivak Island herring biomass was estimated using VMG samples from the Nelson Island District. Recruit herring represented 8.7% of the spawning population (Figure 5). Ages 6 and 7 herring dominated the biomass (Figure 8) and the return in numbers of fish. Age 9 and older herring comprised 20.5% of the biomass.

Cape Romanzof District

Due to excessive water turbidity in the Cape Romanzof area, it is typically not possible to estimate herring biomass using aerial survey techniques. Herring biomass has been estimated using a combination of information from aerial surveys, test and commercial catches, spawn deposition, and age composition. A single aerial survey was flown during the 2003 season on May 16. No estimate of a herring biomass could be calculated because of poor aerial survey conditions. The estimated 2003 preseason biomass ranged between 2,898 and 3,644 tons. Test fishing with VMG has been conducted since 1978 to determine distribution, timing, and relative abundance of spawning herring, and to collect samples for age, sex, size, and relative maturity information.

The Department's test fishing crew sampled 527 herring caught with VMG. Recruit herring, ages 2-5, represented 6.7% of the returning population (Figure 5). Ages 6 and 7 dominated the return in numbers of fish (58.9% and 19.4%, respectively). A summary of the age composition of the returning population is found in Figure 6. Qualitative spawn deposition surveys began on May 13. Artificial substrates were placed in the same general spawning locations as in previous years. Spawn deposited on the substrates was removed and weighed daily at low tide. Daily removal of spawn allows measurement of new spawn deposition and decreases the potential of spawn loss due to wave action and desiccation.

In 2003, the run was approximately seven days earlier than average. Although the Department's crew had arrived early (May 9), a significant spawning event occurred prior to their arrival and was missed. Fresh herring carcasses and spawn were observed on the beach during the initial walk to set up spawning platforms, which occurred on May 11. The first spawn most likely occurred around May 8 and may have been the major spawning event of the season. All spawning platforms were in place by May 13. Spawn was deposited on the spawning platforms on May 18, 20 and 21. On May 18, 323 grams of spawn was collected from spawning platforms. This was the highest measured amount of the season. The total amount of spawn collected during

the study was 508 grams. This is the lowest amount that has ever been documented by the study. However, the spawning event prior to the arrival of the crew was missed and would have increased the platform spawn weight.

Norton Sound District

Since 1978, herring biomass estimates in the Norton Sound District have ranged from 5,291 tons in 1978 to 57,974 tons in 1992 (Table 1). The herring biomass projected to return in 2003 was 25,312 tons. The peak aerial survey took place on May 24 when approximately 31,310 tons of herring were observed. Most of the herring were observed north of Unalakleet in the Cape Denbigh, Norton Bay, Elim, and Golovin Bay Subdistricts. This was above the 25,312 tons of herring that was projected. Weather was good to fair for most of the aerial surveys. The primary spawning was thought to have taken place between May 15 and 20. A total of 47.9 miles of spawn were observed throughout the fishery.

The Department's test fish crew sampled 2,712 herring caught with VMG. Recruit herring, ages 2-5, represented 3.7% of the returning population (Figure 5). Ages 6 and 7 dominated the return in numbers of fish (47.9% and 29.3%, respectively). A summary of the age composition of the returning population is found in Figure 8.

Port Clarence District

Generally, the presence of ice, poor water clarity, or poor weather has prevented aerial surveys in this district. In addition, herring identification is difficult because of the large numbers of saffron cod, whitefish, and other pelagic species typically present in the area. The record biomass for this district of 1,652 tons was sighted during an aerial survey in 1992 (Table 1). No surveys were flown in the Port Clarence District during the 2003 season.

SUBSISTENCE FISHERY

Pacific herring are an important component in the diets of many Yukon-Kuskokwim Delta village residents. Subsistence herring harvest surveys have been conducted annually in Yukon Delta villages and sporadically in Kuskokwim Delta villages since 1975. Subsistence Division has conducted subsistence surveys during several years since 1990 in the Nelson Island and Nunivak Island Districts (Pete 1990, 1991, 1992, 1993). However, herring subsistence surveys have not been conducted in the Nelson Island District since 1996 or in the Nunivak Island District since 1993 (Table 6). Available data suggest that Nelson Island villages harvest approximately 110 tons of herring annually (Pete 1992).

During 2003, an estimated subsistence harvest of 6.0 tons of herring was harvested by 34 fishing families from Hooper Bay, Chevak, and Scammon Bay (Table 6). In addition, 17 families harvested 500 pounds of herring spawn-on-kelp (*fucus*) for subsistence purposes. A total of 205

mail-out questionnaires were sent to households in the communities of Hooper Bay, Chevak, and Scammon Bay. A total of 48 (23%) households responded. The subsistence harvest and effort figures represent only the harvest, which was reported. Therefore, the reported harvest is a minimum estimate since not all fishing families were contacted and not all households who received questionnaires returned them.

The Department sampled 409 herring for biological data from the subsistence harvest in the Nelson Island District. Age 6 herring comprised 48.4% of the subsistence samples. The samples consisted of 14.4% recruit-aged herring (< 6) and 6.0% age > 9 herring.

COMMERCIAL FISHERY

Security Cove District

There were no commercial openings in the Security Cove District in 2003. Generally, permit holders participating in the Security Cove fishery come from the Togiak District once that fishery concludes. In recent years, the Togiak District fishery has typically finished prior to the opening of the commercial fishery in the Security Cove district. In 2003, the Togiak District fishery overlapped with the peak spawning activity in the Security Cove District. As a result, there was no interest from the fishers or buyers in the fishery.

Goodnews Bay District

The total herring harvest was 35.8 tons with an average roe content of 9% (Tables 2 and 3). One processor purchased herring from 12 permit holders who made 41 deliveries in nine periods from May 9 through May 14 with 50.5 hours total fishing time (Tables 4 and 7). Harvests ranged from no harvest on May 13 and May 14 to 8.7 tons on May 10 and May 11 (Table 7). Overall recoverable roe percentages ranged from 7.2% on May 9 to 10.7% on May 12 and May 13. The estimated exvessel value was $4,600. The exploitation rate was 0.4% of the available biomass (Table 2) based on the preseason biomass projection of 5,186 tons. Fishing was discontinued after May 14 due to lack of processor interest. Contributing to lack of processor interest was the decline in fishing effort and low volume of harvest in the district.

A sample of 357 herring was taken from the commercial harvest. Ages 7, 8, and 6 herring comprised 24.1%, 16.0%, and 14%, respectively, of the harvest (Figure 6). Recruits (< 6) comprised 0.6 % of the harvest, age > 9 herring made up over 45% of the harvest.

Cape Avinof District

The total herring harvest was 175.6 tons with an average roe content of 10.5 % (Tables 2 and 3). One processor purchased herring from 22 permit holders who made 135 deliveries in thirteen

periods from May 15 through May 22, with a total fishing time of 74.5 hours (Tables 4 and 7). Harvests ranged from 0.4 tons on May 15 to 46.1 tons on May 17 (Table 7). Overall recoverable roe percentages ranged from 9.7% on May 18 and May 19 to 12.6% on May 20 (Table 7). The estimated exvessel value was $36,100. The exploitation rate was 4.6% (Table 2) based on the preseason biomass projection of 3,812 tons.

A sample of 543 herring was taken from the commercial harvest. Ages 7, 6, and 9 herring comprised 30.2 %, 17.7 % and 13.6 %, respectively, of the harvest (Figure 6). Recruits (< 6) comprised less than 1 % of the harvest, age > 9 herring made up over 27 % of the harvest .

Nelson Island District

The total harvest was 816.5 tons of herring with an average roe content of 10.8 % (Tables 2 and 3). One processor purchased herring from 44 permit holders who made 355 deliveries in fourteen periods from May 14 through May 21, with a total fishing time of 77.5 hours (Tables 4 and 7). Harvests ranged from 0.5 tons on May 14 to 143.4 tons on May 19 and May 20 (Table 7). Overall recoverable roe percentages ranged from10.1 % on May 18 and May 19 to 13.1 % on May 14 (Table 7). The estimated exvessel value was $187,500. The exploitation rate was 16 % (Table 2) based on the preseason biomass projection of 5,120 tons.

A sample of 413 herring was taken from the commercial harvest. Ages 9, 10, and 7 herring comprised 22%, 16.7% and 15.0%, respectively, of the harvest (Figure 6). Recruits (< 6) comprised less than 1% of the harvest, age > 9 herring made up over 43.4% of the harvest.

Nunivak Island District

The Nunivak Island cooperative commercial purse seine herring fishery opened on May 12 and remained open until May 18 (Table 7). Fourteen landings were made for a harvest of 229 tons of sac roe herring with an overall recoverable roe content of 8.4 % (Table 7). Twenty-nine of the registered 30 permit holders participated with one buyer and one purse seine vessel in the cooperative (Table 7). The estimated exvessel value was $7,157. The exploitation rate was 4.4 % (Table 2) based on the preseason biomass projection of 5,182 tons.

A sample of 607 herring was taken from the commercial harvest. Ages 6 and 7 herring comprised 45.6 % and 25.5 %, respectively, of the harvest (Figure 8). Recruits (< 6) comprised 3.5 % of the harvest, age > 9 herring made up over11.4 % of the harvest.

Cape Romanzof District

A total of 81 tons of Pacific herring were harvested by 11 fishers, with an average sac roe recovery 10.9% (Tables 2 and 3). The entire catch was sold as sac roe herring. The 2003 commercial fishery consisted of 14 fishing periods between May 13 and May 20 for a total

fishing time of 64 hours (Tables 4 and 7). Fishing gear was restricted to one 50-fathom gillnet per vessel up until the 10th commercial opening, which occurred during the afternoon high tide on May 18. Because of the small number of fishers participating in the fishery, managers allowed fishers the opportunity to use two shackles of gear (100 fathoms of gillnet). Few fishers took advantage this opportunity because most did not have extra gear. The estimated exvessel value of the 2003 harvest was approximately $8,000 (Table 2). The inseason price for herring sac roe was approximately $150 per ton at 11% roe recovery, including incentives. One company purchased herring and was represented by three tenders during the fishery (Table 4). The overall exploitation rate of herring was estimated postseason to be approximately 2.5% of the available biomass (Table 2).

A sample of 293 herring was taken from the commercial harvest. Ages 10, 12, and 13 herring comprised 20.8, 17.7 %, and 12.6 %, respectively, of the harvest (Figure 8). Recruits (< 6) were not present in commercial sampled fish. Age > 9 herring made up 81.1 % of the harvest (Figure 6).

Norton Sound District

Sac Roe

The total harvest of sac roe herring was 1,587 tons of herring with an average roe recovery of 10.5% (Table 2 and 3). An additional 21 tons of herring was purchased as bait (Table 2). This was the third lowest harvest in the history of the fishery. In Subdistrict 1, a total of 262.4 tons of herring was harvested at 10.7% average roe recovery. In Subdistrict 3, a total of 1,324.6 tons were harvested at 10.4% average roe recovery. Buyers reported harvests with a 10% reduction due to water content. Consequently, staff converted the reported harvest back to wet weights, which has been the standard of reporting weight in Norton Sound for comparison purposes. There were 31 gillnet fishermen (Table 4) who made at least one delivery during the season. This ranked as the lowest effort in the history of the Norton Sound sac roe fishery. No beach seine permit holders were present in Norton Sound in 2003 due to marketing problems.

Two companies were present on the grounds during the 2003 season with 1 processor and 4 tenders registered (Table 4). Based on final operations reports, it is estimated the average price advanced for a short ton of 10% roe herring was $150. The total value of the herring harvest to the sac roe fishermen was approximately $217,320 based on the reported poundage with a 10% reduction due to water content. This averages out to $4,724.35 for each fisherman making a landing. The 2003 season ties with the 1998 season as the second lowest in terms of value for the Norton Sound herring fishery (Table 2).

Spawn-on-kelp

Permit holders wishing to participate in the *Macrocystis* spawn-on-kelp open pound fishery were required to register with the Nome Fish and Game office by April 16. Two permit holders registered as participants in the *Macrocystis* fishery. One fisher deployed kelp during the 2003 season. A total of 1,750 pounds of kelp was harvested. No price information is available at this

time. The department announced one commercial wild spawn-on-kelp opening on May 30. No wild kelp was harvested.

A sample of 779 herring was taken from the commercial harvest. Ages 10, 12, and 7 herring comprised 30.2 %, 17.2 %, and 10.3 %, respectively, of the harvest (Figure 6). Recruits (< 6) were not present in commercial sampled fish. Age > 9 herring made up 74.6 % of the harvest (Figure 8).

Port Clarence District

There has not been a commercial sac roe fishery in the Port Clarence District since 1988 because buyers have not been present in the district. A small bait fishery with a harvest of less than 10 tons occurs in most years. However, there was no bait fishery in Port Clarence in 2003.

ENFORCEMENT

The Division of Fish and Wildlife Protection (FWP) was present in Goodnews Bay, Nelson Island, and Cape Avinoff Districts this year. Most fishers complied with fishery period opening and closing times and buyers were timely and accurate with verbal reporting of purchases. Two individuals in 2003 were cited in the Cape Avinof District for commercial fishing after a period closure. There was no Fish and Wildlife Protection officer on the grounds in Norton Sound or Cape Romanzof Districts in 2003.

OUTLOOK AND MANAGEMENT STRATEGY FOR 2004

Projections from postseason escapement estimates suggest that the 2004 spawning biomass for northeastern Bering Sea herring stocks (Security Cove to Norton Sound) will be 62,922 tons, with an anticipated allowable harvest of 12,381 tons (Table 5). The methods for projecting herring returns in the AYK region are described in Hamner and Bromaghin (1999). If the return is as expected, a small reduction in biomass will be observed in all districts. This decline is primarily caused by natural mortality of the older year classes.

Variability in the quality of aerial survey assessments of biomass and deviations from the assumed survival or recruitment rates may result in the observed biomass being either above or below these projections. Therefore, guideline harvest levels may be adjusted during the season according to observed herring spawning biomass. If determining herring abundance using aerial survey methods is not possible, stock abundance will be assessed using information from the projected biomass, test and commercial catches and spawn deposition observations. In addition, in accordance with the AYK Region harvest strategy, the commercial fishery will not target newly recruited age classes (age 2 through age 5 herring). In all districts, the Department will work cooperatively with fishers

and buyers to optimize roe recovery. Declining market conditions are expected to continue affecting harvests, effort, and value in 2004. In each district, the occurrence and length of fishing periods will depend on inseason abundance estimates, roe quality, spawning activity, weather conditions, fishing effort and processor interest.

Security Cove District

The 2004 projected return to the Security Cove District is 9,698 tons. A 20% exploitation rate would result in a harvest of 1,940 tons (Table 5). Commercial fishing will not be allowed until the observed biomass reaches 1,200 tons, or significant spawning activity is observed. Ages 7, 8 and 9 are expected to comprise 74.5 % of the returning biomass (35.4 %, 30.5 % and 8.6 %, respectively). Age 9 and older herring are expected to comprise 31.2 % of the biomass.

Goodnews Bay District

The management strategy for this district will be similar to that planned for Security Cove. The season will open and close by emergency order when a biomass of 1,200 tons, or significant spawning activity is observed. The 2004 projected return of herring to the Goodnews Bay District is 7,744 tons. A 20% exploitation rate would result in a harvest of 1,549 tons (Table 5). Ages 8, 7, and 9 herring are expected to dominate the biomass, contributing 33.7 %, 29.4 %, and 13.4 %, respectively. Age 9 and older herring are expected to comprise 33.3 % of the biomass.

Cape Avinof District

The 2004 projected biomass for the Cape Avinof District is 3,369 tons (Table 5). Either significant spawning activity or a biomass of 500 tons must be observed before the commercial herring season can be opened. The exploitation rate will be no greater than 15% because of the limited database for this area and to ensure the subsistence fishing priority. A 15% commercial exploitation rate would result in a harvest of 505 tons. Ages 7, 8 and 9 are expected to comprise 75.6 % of the returning biomass (35.7 %, 30.7 % and 9.3 %, respectively). Age 9 and older herring are expected to comprise 30.8 % of the biomass.

Nelson Island District

In the Bering Sea Herring Fishery Management Plan, a minimum biomass threshold of 3,000 tons for the Nelson Island District. The inseason estimate of herring biomass must exceed the threshold level before a commercial fishery can be allowed.

The spawning biomass projected to return in 2004 to the Nelson Island District is 5,085 tons (Table 5). At an exploitation rate of 20%, minus 200 tons for subsistence harvest, the commercial harvest will be 817 tons.

To provide additional protection for the subsistence herring fishery, the following guidelines will be followed:

1. Two hundred tons of the exploitable biomass will be set aside for subsistence.
2. Periodic closures of the commercial fishery will be scheduled, during which only subsistence fishing will be allowed.
3. Several important subsistence use areas occur throughout the district, including the waters around Cape Vancouver. Specific areas may be closed to commercial fishing to insure the adequacy of subsistence harvests.
4. The Department will by all available means, including acting on input from local residents, insure the adequacy of subsistence herring harvests during the commercial fishing season.

Ages 7, 8, and 10 are expected to dominate the returning population, contributing 39.8 % and 23.7 %, and 9.3 %, respectively. Age 9 and older herring are expected to comprise 29.1 % of the biomass.

Nunivak Island District

The biomass of herring projected to return in 2002 to the Nunivak Island District is 4,739 tons. A 20% exploitation rate would result in a harvest of 948 tons (Table 5). The commercial season will open when the biomass reaches 1,500 tons, or when significant spawning is observed. Ages 7, 8, and 9 are expected to dominate the returning biomass, contributing 39.7 %, 23.6 %, and 9.3 %, respectively. Age 9 and older herring are expected to comprise 29 % of the return.

Cape Romanzof District

The projected biomass for 2004, based on limited data, is expected to range from 3,000 to 4,000 tons with a midpoint of 3,500 tons. At a 20% exploitation rate, the guideline harvest based on this projection would range from 600 to 800 tons with a midpoint of 700 tons (Table 5). Since water turbidity in the Cape Romanzof area generally prevents aerial observations of herring, spawn deposition and test and commercial catch rates will be used to determine the timing and duration of commercial fishing periods. Ages 7, 8, and 11 herring are expected to dominate the biomass, contributing 56.9 %, 21.0 %, and 5.3 %, respectively. Age 9 and older herring are expected to comprise 16.2 % of the return.

Norton Sound District

The biomass projected to return in 2004 to Norton Sound is 28,787 tons. A 20% exploitation rate would result in a harvest guideline of 5,757 tons (Table 5). A maximum of 320 tons of herring are reserved to allow for the pound fishery to harvest a maximum of 90 tons of product (combined weight of herring roe and kelp) (5AAC 27.965). This leaves 5,437 tons for sac roe harvest. The

beach seine harvest is, by regulation, 10% of the sac roe projected harvest, or 544 tons. Inseason assessment of herring biomass will supersede projected biomass for management of the Norton Sound herring fishery, except where weather prevents obtaining an inseason estimate.

The 2004 herring fishery will be opened by emergency order and the fishery will close by emergency order when up to 20% of the available herring biomass has been harvested. Varied harvest rates may be applied to individual subdistricts based on biomass distribution, roe quality, weather, and sea ice conditions. Ages 7, 8 and 12 are expected to dominate the returning biomass (44.6 %, 29.7 % and 9.2 %, respectively). Age 9 and older herring are expected to comprise 22.6 % of the return.

Port Clarence District

Generally, the Department does not project an outlook for the Port Clarence fishery because of the lack of data on Port Clarence herring and the limited scope of the fishery. The guideline harvest of 165 tons was established by the Board of Fisheries in 1981. This harvest guideline is based on two years of research conducted by the Department in both the Port Clarence and Kotzebue Districts. Even though this guideline has not appeared in the regulation book since 1984, it still represents the best estimate of harvestable biomass.

REGULATION PROPOSALS FOR JANUARY 2004 BOARD MEETING

Three regulation proposals from the public dealing with the AYK herring fisheries will be taken up at the January 2004 Board of Fisheries meeting. Two of the proposals are attempting to address the impact of poor market conditions on herring fisheries. Proposal A originated as a petition to open the entire Cape Romanzof District to commercial fishing. Presently, only Kokechik Bay within the district is open to fishing. If more area is open to fishing, there may be an increase in fishing effort and harvest. Proposal number 142 asks to rescind the superexclusive use designation for Goodnews Bay District. Again, this proposal may result in an increase in participation in the fishery. Proposal number 123 would allow a herring bait fishery during the CDQ crab fishery.

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Table 1. Pacific herring estimated biomass in the northeastern Bering Sea, Alaska, 1978-2003.

	Herring (tons)									
Year	Security Cove	Goodnews Bay	Cape Avinof	Nelson Island	Nunivak Island	Cape Romanzof [a]	Norton Sound	Port Clarence	Total Biomass	5 Year Average[b]
1978	1,323	441	-	5,952	805	2,976	5,291	-	16,788	
1979	21,495	7,385	-	5,952	-	2,976	7,716	-	45,524	
1980	1,213	1,213	-	5,952	-	2,976	8,377	-	19,731	
1981	8,267	4,299	-	3,968	19	4,850	22,360	-	44,331	
1982	5,071	2,646	-	3,968	-	4,850	19,403	-	33,951	
1983	6,393	3,197	-	7,275	7,606	5,512	26,841	-	58,092	32,065
1984	5,071	4,079	-	11,023	6,695	6,063	21,475	-	56,079	40,326
1985	4,900	4,300	2,000	9,500 [g]	5,700 [g]	7,000	20,000	-	51,400	42,437
1986	3,700 [g]	3,000 [g]	-	7,300 [g]	6,000	7,500	28,100	-	55,600	48,771
1987	2,300 [g]	2,000 [g]	1,225	8,100	4,400 [g]	7,200	32,370	932	57,332	51,024
1988	4,906	4,479	4,108	7,152	2,800 [g]	6,600	33,924	788	64,757	55,701
1989	2,830	4,040	2,780 [g]	3,320	620	4,400	25,981	-	43,970	57,034
1990	2,650	2,577	2,020 [g]	2,705	422	4,500	39,384	-	54,258	54,612
1991	4,434	4,387	2,083	2,385	3,903	4,500	42,854	-	64,546	55,183
1992	7,773	5,572	3,446	5,275	5,703	4,500	57,974	1,652	91,895	56,973
1993	6,995	6,211	2,837 [g]	4,944	5,176	4,000	46,549	822	77,534	63,885
1994	7,638 [g]	5,679 [g]	2,827 [g]	5,564	4,921	5,000	37,829	92	69,550	66,441
1995	6,702 [g]	4,219 [g]	3,627 [g]	7,754	4,579 [g]	5,000	37,779	-	69,660	71,557
1996	6,867	6,315	4,500 [g]	6,638 [g]	4,195 [g]	6,000	27,307 [g]	-	61,822	74,637
1997	4,640 [g]	4,752 [g]	4,600 [g]	7,900 [g]	3,801 [g]	5,000 [d]	47,791	-	78,484	74,092
1998	4,017 [g]	4,064 [g]	4,287 [g]	7,136 [g]	3,778 [g]	4,500 [e]	52,033	-	79,815	71,410
1999	5,261	6,896	3,555 [g]	6,655	3,319 [g]	3,800 [f]	34,314	-	63,800	71,866
2000	5,237	6,348	3,210 [g]	4,672 [i]	3,487	3,500 [g]	32,680	-	59,134	70,716
2001	5,206	5,755 [g]	3,486 [g]	6,057	5,657	2,700 [h]	26,305	-	55,166	68,611
2002	4,748	5,529 [g]	3,491 [g]	6,130	5,422	3,600	27,068	-	55,988	67,280
2003	10,600	8,300	3,812 [g]	6,130 [g]	5,182 [g]	3,685 [i]	32,918	-	70,627	62,781

[a] Biomass estimate based on limited aerial survey information, spawn deposition, age composition, and CPUE from commercial and test fisheries.

[b] Average of total biomass for preceeding 5 years

[g] Unacceptable aerial survey conditions for estimating herring biomass, therefore projected biomass or some other method of estimating biomass was used.

[d] Biomass listed for Cape Romanzof is midpoint for estimated range of 4,500 to 5,500 tons.

[e] Biomass listed for Cape Romanzof is midpoint for estimated range of 4,000 to 5,000 tons.

[f] Biomass listed for Cape Romanzof is midpoint for estimated range of 3,300 to 4,300 tons.

[g] Biomass listed for Cape Romanzof is midpoint for estimated range of 3,000 to 4,000 tons.

[h] Biomass listed for Cape Romanzof is midpoint for estimated range of 2,400 to 3,000 tons.

[i] Biomass listed for Cape Romanzof is midpoint for estimated range of 3,169 to 4,202 tons.

Table 2. Estimated biomass and commercial harvest of Pacific herring in northeastern Bering Sea fishing districts, Alaska, 1994-2003.

Year	District	Estimated Biomass (tons)	Harvest (tons) Sac roe	Bait	Waste	Total	Roe %	Estimated Value ($ x 1,000)	Exploitation Rate (%)
2003	Security Cove [b]	10,600	-	-	-	-	-	-	-
	Goodnews Bay	8,300	36	0	0	36	9.0	4.6	0.4
	Cape Avinof	3,812 [a]	176	0	0	176	10.5	36.1	4.6
	Nelson Island	6,130	817	0	0	817	10.8	187.5	16.0
	Nunivak Island	5,182	229	0	0	229	8.4	7.2	4.4
	Cape Romanzof	3,685 [a]	81	0	0	81	10.9	8	2.5
	Norton Sound	32,918	1,587	21	0	1,608	10.5	217 [c]	4.9
Total		70,627	2,924	21	0	2,945	9.8	461	4.2
2002	Security Cove	4,748	96	3	0	99	9.7	921	2.1
	Goodnews Bay	5,529 [a]	13	0	0	13	9.7	1	0.2
	Cape Avinof	3,491 [a]	79	0	0	79	9.6	8	2.3
	Nelson Island	6,130	950	0	0	950	10.4	101	15.5
	Nunivak Island	5,422	176	0	0	176	7.6	19	3.3
	Cape Romanzof	3,600 [a]	100	0	0	100	9.9	13	2.8
	Norton Sound	27,068	1,059	64	0	1,123	10.6	160 [c]	4.2
Total		55,988	2,473	67	0	2,540	9.7	1,223	4.5
2001	Security Cove	5,206	1,024	0	0	1,024	10.7	110	19.7
	Goodnews Bay	5,755 [a]	45	0	0	45	11.3	6	0.8
	Cape Avinof	3,486 [a]	231	0	0	231	9.8	23	6.6
	Nelson Island	6,057 [a]	678	0	0	678	10.4	66	11.2
	Nunivak Island [b]	5,657	-	-	-	-	-	-	-
	Cape Romanzof	2,700 [a]	57	80	0	137	7.6	10	5.1
	Norton Sound	26,305 [a]	2,245	0	0	2,245	12.6	348 [a]	8.5
Total		55,166	4,280	80	0	4,360	11.6	563	7.9
2000	Security Cove	5,237	284	15	0	299	10.7	62	5.7
	Goodnews Bay	6,348	19	1	1	20	9.2	3	0.3
	Cape Avinof	3,210 [a]	370	7	0	377	9.6	71	11.8
	Nelson Island	4,672 [a]	754	52	1	807	9.8	150	17.3
	Nunivak Island	3,487	41	0	0	41	9.9	12	1.2
	Cape Romanzof	3,500 [a]	313	187	0	500	9.1	77	14.3
	Norton Sound	32,680	5,472	0	15	5,487	9.4	894 [a]	13.7
Total		59,134	6,252	262	17	6,531	9.5	1,269	11.0
1999	Security Cove	5,261	1,016	56	1	1,072	11.0	338	20.4
	Goodnews Bay	6,896	1,332	33	0	1,366	11.3	301	19.8
	Cape Avinof	3,555 [a]	516	18	0	533	11.0	185	15.0
	Nelson Island	6,655	1,267	97	2	1,366	11.2	430	20.5
	Nunivak Island [b]	3,319 [a]	-	-	-	-	-	-	-
	Cape Romanzof	3,800 [a]	378	155	0	533	10.2	127	14.0
	Norton Sound	34,314	2,702	53	5	2,760	10.5	615 [a]	8.0
Total		63,800	7,211	412	8	7,630	10.9	1,996	12.0
1998	Security Cove	4,017 [b]	1,012	0	0	1,012	11.5	232	25.2
	Goodnews Bay	4,064 [a]	831	0	0	831	11.3	118	20.5
	Cape Avinof	4,287 [a]	656	0	0	656	11.6	152	15.3
	Nelson Island	7,136 [a]	1,250	0	0	1,250	11.8	296	17.5
	Nunivak Island	3,778 [a]	202 [d]	0	0	202	9.8	26 [e]	5.4
	Cape Romanzof	4,500 [a]	617	110	0	727	10.0	131	16.2
	Norton Sound	52,033	2,624	8	0	2,632	9.2	203 [a]	5.1
Total		79,815	7,192	118	0	7,310	10.2	1,158	9.2
1997	Security Cove	4,640 [a]	884	3	5	892	12.5	221	19.2
	Goodnews Bay	4,752 [a]	805	0	0	805	14.2	228	16.9
	Cape Avinof	4,600 [a]	687	0	0	687	11.5	157	14.9
	Nelson Island	7,900 [a]	778	0	0	778	12.7	198	9.8
	Nunivak Island	3,801 [a]	0	0	0	0	-	-	0
	Cape Romanzof	5,000 [a]	879	0	0	879	10.2	186	17.6
	Norton Sound	47,791	3,709	263	5	3,976	9.9	612	8.3
Total		78,484	7,742	266	10	8,017	11.1	1,602	10.2
1996	Security Cove	6,867	1,795	59	5	1,859	11.6	1,251	27.1
	Goodnews Bay	6,315	1,191	13	0	1,204	12.5	895	19.1
	Cape Avinof	4,500 [a]	820	0	0	820	13.4	659	18.2
	Nelson Island	6,638 [a]	986	44	0	1,030	11.4	679	15.5
	Nunivak Island	4,195 [a]	61	40	0	101	9.9	39	2.4
	Cape Romanzof	6,000 [a]	750	1	0	752	10.6	638	12.5
	Norton Sound	27,307 [a]	6,061	109	50	6,220	10.6	4,569	22.8
Total		61,822	11,664	266	55	11,986	11.2	8,730	19.4

[a] Inseason biomass estimate from poor aerial survey, therefore projected biomass or some other method of estimating biomass was used

[b] No commercial fishery.

[c] Includes values from sac-roe fishery only, does not include directed bait, or kelp fisheries values.

[d] Includes 200 tons from the purse seine catch associated with an aerial survey calibration study.

[e] Includes estimated value of $25,000 for the purse seine catch associated with an aerial survey calibration study

Table 3. Pacific herring harvests by commercial fishers during the sac roe fisheries in the northeastern Bering Sea, Alaska, 1909-2003.

	Herring (tons) [a]									Spawn on kelp (tons)
Year	Security Cove	Goodnews Bay	Cape Avinof	Nelson Island	Nunivak Island	Cape Romanzof	Norton Sound	Port Clarence	Total Harvest	Norton Sound
1916-1928	-	-	-	-	-	-	1,881	-	1,881	-
1929	-	-	-	-	-	-	160	-	160	-
1930	-	-	-	-	-	-	441	-	441	-
1931	-	-	-	-	-	-	86	-	86	-
1932	-	-	-	-	-	-	529	-	529	-
1933	-	-	-	-	-	-	31	-	31	-
1934	-	-	-	-	-	-	4	-	4	-
1935	-	-	-	-	-	-	15	-	15	-
1936	-	-	-	-	-	-	-	-	-	-
1937	-	-	-	-	-	-	6	-	6	-
1938	-	-	-	-	-	-	10	-	10	-
1939	-	-	-	-	-	-	6	-	6	-
1940	-	-	-	-	-	-	14	-	14	-
1941	-	-	-	-	-	-	3	-	3	-
1942-1944	-	-	-	-	-	-	-	-	-	-
1945	-	-	-	-	-	-	-	-	-	-
1946	-	-	-	-	-	-	-	-	-	-
1947-1963	-	-	-	-	-	-	-	-	-	-
1964	-	-	-	-	-	-	20	-	20	-
1965	-	-	-	-	-	-	-	-	-	-
1966	-	-	-	-	-	-	12	-	12	-
1967	-	-	-	-	-	-	-	-	-	-
1968	-	-	-	-	-	-	-	-	-	
1969	-	-	-	-	-	-	2	-	2	-
1970	-	-	-	-	-	-	8	-	8	-
1971	-	-	-	-	-	-	20	-	20	-
1972	-	-	-	-	-	-	17	-	17	-
1973	-	-	-	-	-	-	38	-	38	-
1974	-	-	-	-	-	-	2	-	2	-
1975	-	-	-	-	-	-	-	-	-	-
1976	-	-	-	-	-	-	9	-	9	-
1977	-	-	-	-	-	-	11	-	11	43
1978	286	-	-	-	-	-	15	-	301	4
1979	424	90	-	-	-	-	1,292	-	1,806	13
1980	697	448	-	-	-	911	2,452	-	4,208	24
1981	1,173	657	-	-	-	720	4,371	-	6,921	47
1982	113	486	-	-	-	457	3,953	-	5,889	38
1983	1,673	435	-	-	-	316	4,582	-	6,906	29
1984	135	717	-	-	-	1,185	3,862	-	5,899	19
1985	733	724	-	977	350	1,299	3,548	-	7,639	-
1986	751	557	-	886	511	1,365	5,194	-	9,764	-
1987	113	321	-	923	414	1,342	4,082	146	7,541	-
1988	224	483	348	775	-	1,119	4,672	80	7,801	-
1989	154	616	129	233	116	926	4,771	-	7,345	-
1990	154	433	10	-	-	129	6,439	-	7,307	-
1991	570	263	267	-	59	326	3,672	-	7,357	-
1992	634	740	431	246	27	350	-	-	2,828	-
1993	5	954	215	739	-	571	1,079	-	7,363	-
1994		1,062	427	717	14	456	960	-	3,636	-
1995	1,292	1,054	485	1,113	41	241	6,773	-	11,289	-
1996	1,650	1,264	820	1,030	101	762	6,220	-	11,986	-
1997	892	805	687	778	0	879	3,976	-	8,017	-
1998	1,012	831	656	1,250	202 [d]	727	2,632 [b]	-	7,310	9
1999	1,072	1,366	533	1,266	-	535	2,760 [b]	-	7,630	4
2000	799	20	377	807	41	500	4,487	-	6,551	2
2001	1,024	45	231	678	-	137	2,245	-	4,360	2
2002	99	13	79	950	176	100	1,123	-	2,540	-
2003	-	36	176	817	229	81	1,608 [b]	-	2,945	2

[a] Pre-1964 harvest primarily in the summer and fall for food, post-1964 harvest primarily the in spring for sac roe. Waste is included.

[b] Fishery occurred some years but harvest data is unavailable.

[c] Additional 3 tons harvested from unguarded kelp (*Macrocystis* sp.) not included.

[d] Includes 200 tons harvested with purse seine during an aerial survey calibration study.

[e] Includes 83 tons harvested during a directed bait fishery.

[f] Includes 1,200 lbs of wild kelp and 10,000 lbs of *Macrocystis* kelp.

[g] Includes 83 tons harvested during a directed bait fishery.

[h] Includes 20.5 tons harvested during a directed bait fishery.

Table 4. Number of buyers and fishers participating in northeastern Bering Sea Pacific herring fisheries, Alaska, 1996-2003.

Year	District	Number of Buyers	Number of Fishermen		
			Gillnet	Seine [a]	Totals
2003	Security Cove [b]	-	-	-	-
	Goodnews Bay	1	12	-	-
	Cape Avinof	1	22	-	-
	Nelson Island	1	44	-	-
	Nunivak Island	1	0	29	-
	Cape Romanzof	1	11	-	-
	Norton Sound	2	31	0	32 [c]
2002	Security Cove	5	24	-	-
	Goodnews Bay	1	5	-	-
	Cape Avinof	1	37	-	-
	Nelson Island	1	54	-	-
	Nunivak Island	1	0	29	-
	Cape Romanzof	1	21	-	-
	Norton Sound	2	46	0	46
2001	Security Cove	6	56	-	-
	Goodnews Bay	1	23	-	-
	Cape Avinof	1	45	-	-
	Nelson Island	1	49	-	-
	Nunivak Island	0	0	0	-
	Cape Romanzof	1	24	-	-
	Norton Sound	3	73	0	76 [d]
2000	Security Cove	10	79	-	-
	Goodnews Bay	2	57	-	-
	Cape Avinof	1	86	-	-
	Nelson Island	4	86	-	-
	Nunivak Island	1	0	35	-
	Cape Romanzof	2	46	-	-
	Norton Sound	4	91	3	97 [e]
1999	Security Cove	8	87	-	-
	Goodnews Bay	5	94	-	-
	Cape Avinof	3	117	-	-
	Nelson Island	4	94	-	-
	Nunivak Island	0	0	-	-
	Cape Romanzof	1	57	-	-
	Norton Sound	4	119	0	122 [f]
1998	Security Cove	9	78	-	-
	Goodnews Bay	2	84	-	-
	Cape Avinof	2	109	-	-
	Nelson Island	2	86	-	-
	Nunivak Island	1	7	1	8 [g]
	Cape Romanzof	1	41	-	-
	Norton Sound	2	35	0	47 [h]
1997	Security Cove	14	222	-	-
	Goodnews Bay	3	139	-	-
	Cape Avinof	2	145	-	-
	Nelson Island	3	105	-	-
	Nunivak Island	1	12	-	-
	Cape Romanzof	3	65	-	-
	Norton Sound	9	214	6	220
1996	Security Cove	14	326	-	-
	Goodnews Bay	5	182	-	-
	Cape Avinof	2	161	-	-
	Nelson Island	3	109	-	-
	Nunivak Island	2	24	-	-
	Cape Romanzof	3	63	-	-
	Norton Sound	10	281	6	287

[a] Beach seine gear prohibited in all districts except Norton Sound and Port Clarence. Purse seine gear allowed only in the Nunivak Island District.

[b] No commerical openings.

[c] Includes 31 gillnet fishers and 1 kelp fisher.

[d] Includes 73 gillnet fishers and 3 kelp fishers.

[e] Includes 91 gillnet fishers, 3 beach seine fishers and 3 kelp fishers.

[f] Includes 119 gillnet fishers, 1 bait fisher and 2 kelp fishers.

[g] Includes 7 gillnet fishers and 1 purse seine fisher.

[h] Includes 35 gillnet fishers, 1 bait fisher and 11 kelp fishers.

Table 5. Pacific herring spawning biomass, harvest guideline, and exploitation in commercial fishing districts in the northeastern Bering Sea, Alaska for 2003 and projections for 2004.

	2003					2004		
District	Estimated Biomass (tons)	Harvest Guideline (tons)	Harvest	Exploitation Rate	Remainder (unharvested)	Projected [a] Biomass (tons)	Max. Exploitation Rate (%)	Harvest (tons) [a] Guideline
Security Cove	10,600	2,120	0	0.0	2,120	9,698	20	1,940
Goodnews Bay	8,300	1,700	36	0.4	1,664	7,744	20	1,549
Cape Avinof	3,812	570	175	4.6	395	3,369	15	505
Nelson Island	6,130	836	817	13.3	20	5,085	16	817 [b]
Nunivak Island	5,182	1,036	229	4.4	807	4,739	20	948
Cape Romanzof	3,685	655	87	2.3	569	3,500 [c]	20	700 [c]
Norton Sound	32,918	5,062	1,587	4.8	3,475	28,787	20	5,757
Port Clarence	-	165	-	-	165	-	-	165 [d]
Totals	70,627	12,145	2,930		9,215	62,922		12,381

[a] Preseason projection. Biomass and harvest may be adjusted based on inseason estimates.

[b] Nelson Island commercial harvest is 20% of projected biomass minus 200 tons for subsistence harvest.

[c] Projection from midpoint of 2003 biomass estimate of 3,169 to 4,202 tons. Allowable harvest will range from 600 to 800 tons based on inseason indicators of abundance.

[d] Harvest guideline of 165 tons.

Table 6. Pacific herring subsistence harvest (tons) and effort data from selected northeastern Bering Sea areas, Alaska, 1978-2003.[a]

Village	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Nelson Island																										
Tununak	38	34	65	40	48	94	-	43	63	48	49	47	54		32	45	42	30	26	-	-	-	-	-	-	-
Umkumiut	11	8	3	10	0	-	-	-	-	c	c	c	c	x	c	-	-	-	-	-	-	-	-		-	-
Toksook Bay	37	51	29	14	35	-	-	46	70	51	58	52	46	40	43	23	53	46	42	-	-	-	-		-	-
Nightmute	-	-	-	-	-	-	-	3[b]	21	15	16	15	18	8	10	9	13	13	16	-	-	-	-	-	-	-
Newtok	-	-	-	-	-	-	-	7[b]	13	10	12	10	8	1	7	6	9	9	12	-	-	-	-	-	-	-
Total	86	93	97	64	83	94	-	99	167	124	136	124	126	70	92	82	117	98	95	-	-	-	-	-	-	-
No. Fishing Families	83	54	70	93	65	43	-	65[b]	72[b]	96	104	[b]	100	85	97	89	-	91	96	-	-	-	-	-	-	-
Nunivak Island																										
Mekoryuk	-	-	-	-	-	-	-	<1	<1	-	-	-	5	4	4	2	-	-	-	-	-	-	-	-	-	-
No. Fishing Families	-	-	-	-	-	-	-	11	6[b]	-	-	-	59	20	17	16	-	-	-	-	-	-	-	-	-	
Other Kuskokwim Delta																										
Chefornak	-	-	-	-	-	-	-	13[b]	-	14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Kipnuk	-	-	-	-	-	-	-	9	-	14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Kongiganak	-	-	-	-	-	-	-	3	2[b]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Kwigillingok	-	8	13	-	13	-	-	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	-	8	13	-	13	-	-	30	2	28	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
No. Fishing Families	-	22	19	-	21	-	-	55[b]	12[b]	49	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Yukon Delta																										
Scammon Bay	1	6	3	8	4	3	4	2	2	1	2	1	2	1	1	3	1	1	1	1	<1	6	4	2	<1	3
Chevak	-	2	4	2	2	1	3	2	1	1	2	<1	1	<1	<1	<1	2	1	<1	<1	<1	2	1	1	<1	1
Hooper Bay	4	3	4	4	5	5	4	4	4	1	4	2	6	2	2	2	3	4	2	2	1	4	1	<1	1	2
Total	5	11	11	14	11	9	11	8	6	3	7	3	8	3	4	5	6	6	3	3	2	13	6	3	2	6
No. Fishing Families	30	84	61	45	43	37	47	44	40	23	32	24	32	18	30	42	48	42	29	34	15	67	50	23	20	34

[a] Subsistence survey results are believed to accurately reflect harvest trends, however, reported catches reflect minimum figures since all fishermen cannot be contacted.

[b] Fishing families were not interviewed or only a portion of fishing families were interviewed as harvest was enumerated while on drying racks.

[c] Umkumiut effort was included with Tununak.

Table 7. Summary of Pacific herring commercial harvest by fishing period for northeastern Bering Sea fishing districts, Alaska, 2003.

District	Subdistrict	Gear	Period	Date	Time	Total Hours	Harvest (tons)
Security Cove		No Commercial Fishery					
Goodnews Bay		Gillnet	1	5/9	12:00 - 16:30	4.5	4.6
			2	5/10	12:00 - 16:00	4.0	7.2
			3	5/10	23:30 - 05:30	6.0	8.7
			4	5/11	12:00 - 18:00	6.0	5.0
			5	5/12	00:30 - 06:30	6.0	3.2
			6	5/12	13:00 - 19:00	6.0	6.4
			7	5/13	01:00 - 07:00	6.0	0.8
			8	5/13	14:00 - 20:00	6.0	0.0
			9	5/14	02:00 - 08:00	6.0	0.0
					Total	50.5	35.9
Cape Avinof		Gillnet	1	5/15 - 16	20:00 - 01:00	5.0	0.4
			2	5/16	08:00 - 13:00	5.0	1.0
			3	5/16 - 17	20:00 - 01:30	5.5	28.6
			4	5/17	08:30 - 14:00	5.5	10.7
			5	5/17 - 18	20:00 - 01:30	5.5	46.1
			6	5/18	09:00 - 15:00	6.0	1.9
			7	5/18 - 19	20:30 - 02:30	6.0	28.5
			8	5/19	09:30 - 16:30	6.0	2.8
			9	5/19 - 20	22:30 - 04:30	6.0	30.3
			10	5/20	11:30 - 17:30	6.0	4.0
			11	5/20 - 21	23:30 - 05:30	6.0	7.5
			12	5/21	12:30 - 18:30	6.0	5.7
			13	5/22	00:30 - 06:30	6.0	8.1
					Total	74.5	175.6
Nelson Island		Gillnet	1	5/14	21:00 - 23:00	2.0	0.5
			2	5/15	06:00 - 12:00	6.0	3.3
			3	5/15 - 16	20:00 - 02:00	6.0	3.7
			4	5/16	08:00 - 14:00	6.0	6.6
			5	5/16 - 17	21:00 - 03:00	6.0	47.9
			6	5/17	09:00 - 15:00	6.0	90.3
			7	5/17 - 18	22:00 - 04:00	6.0	69.1
			8	5/18	10:30 - 15:30	5.0	56.3
			9	5/18 - 19	22:30 - 03:30	5.0	103.1
			10	5/19	11:00 - 18:00	5.0	89.7
			11	5/19 - 20	23:00 - 06:30	7.5	143.4
			12	5/20	12:00 - 17:00	5.0	38.5
			13	5/21	00:01 - 06:30	6.5	124.5
			14	5/21	13:00 - 19:00	6.0	59.6
					Total	78.0	816.5
Nunivak Island		Purse Seine	1	5/12 - 18	20:00 - 08:00	204.0	229.0
					Total	204.0	229.0
Cape Romanzof		Gillnet	1	5/13	10:00 - 14:00	4.0	0.0
			2	5/13 - 14	23:00 - 03:00	4.0	0.0
			3	5/15	00:00 - 04:00	4.0	1.8
			4	5/15	11:30 - 15:30	4.0	0.0
			5	5/15 - 16	22:00 - 03:00	5.0	4.3
			6	5/16	11:00 - 15:00	4.0	0.0
			7	5/16 - 17	22:00 - 03:00	5.0	0.9
			8	5/17	12:00 - 16:00	4.0	2.4
			9	5/17 - 18	23:00 - 04:00	5.0	6.2
			10	5/18	13:00 - 18:00	5.0	24.7
			11	5/19	00:00 - 05:00	5.0	9.2
			12	5/19	14:00 - 19:00	5.0	12.5
			13	5/20	01:00 - 06:00	5.0	6.7
			14	5/20	15:00 - 20:00	5.0	10.9
					Total	64.0	79.6
Norton Sound [a]	5	Gillnet		5/16	continuous		1.6
	5			5/17			263.3
	5			5/18			408.3
	3			5/20			162.0
	3			5/21			117.0
	1, 3			5/22			60.6
	1, 5			5/23			349.6
	1			5/24			64.4
	1			5/25			1.5
					Total		1,428.3
	All	Open Pound	1	5/16 - 5/25	continuous		0.9[b]

[a] Fishery was open continuously from 5/16 to 5/25

[b] Product weight

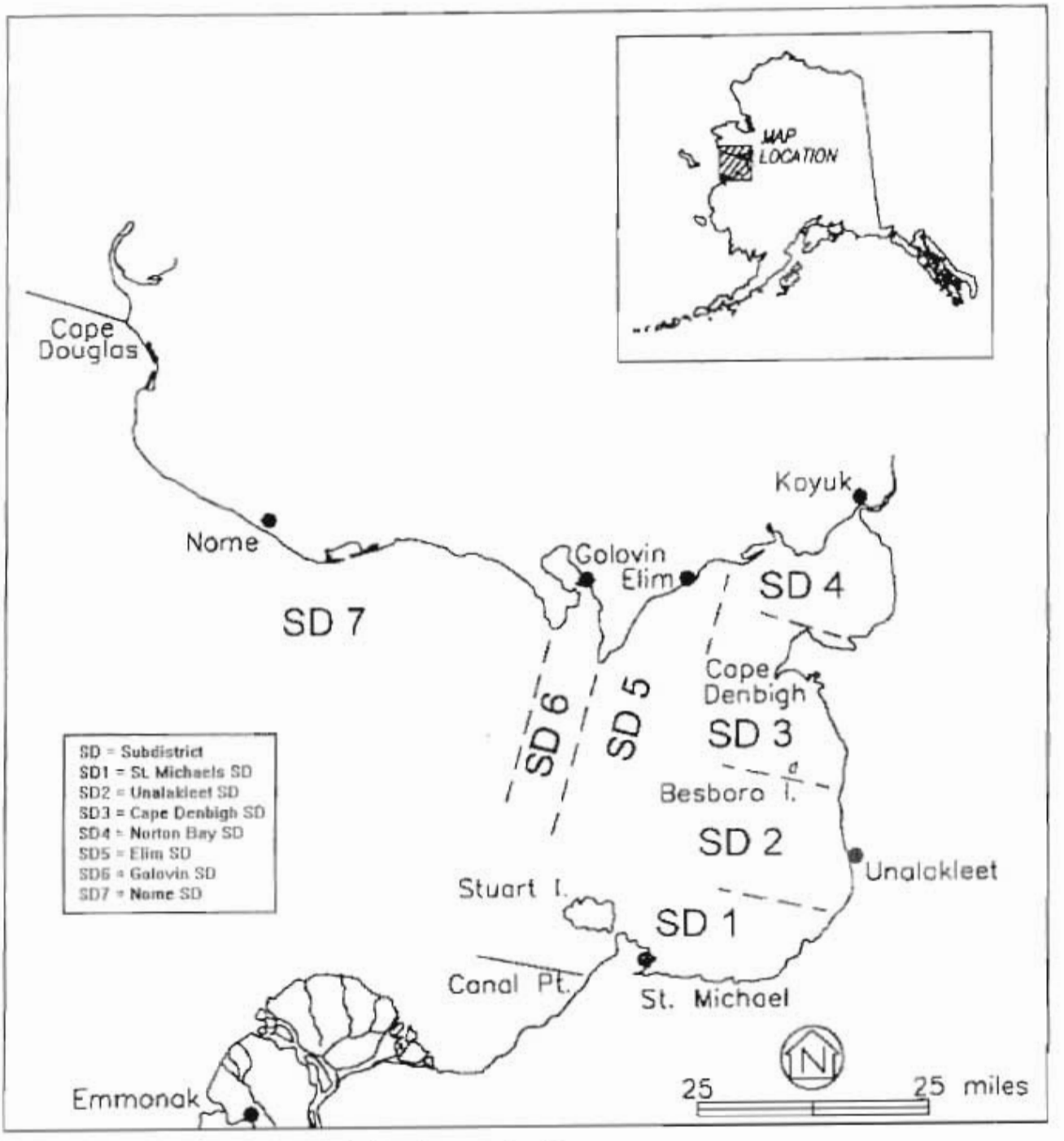

Figure 2. Norton Sound commercial herring subdistricts.

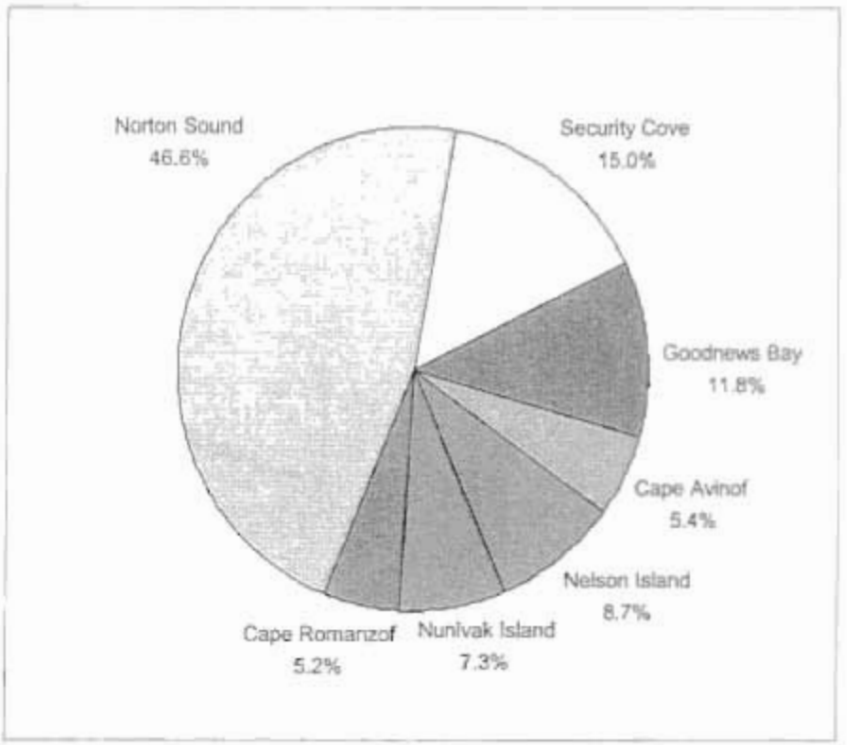

Figure 3. Pacific herring biomass distribution by commercial fishing district, Arctic-Yukon-Kuskokwim Region, Alaska, 2003.

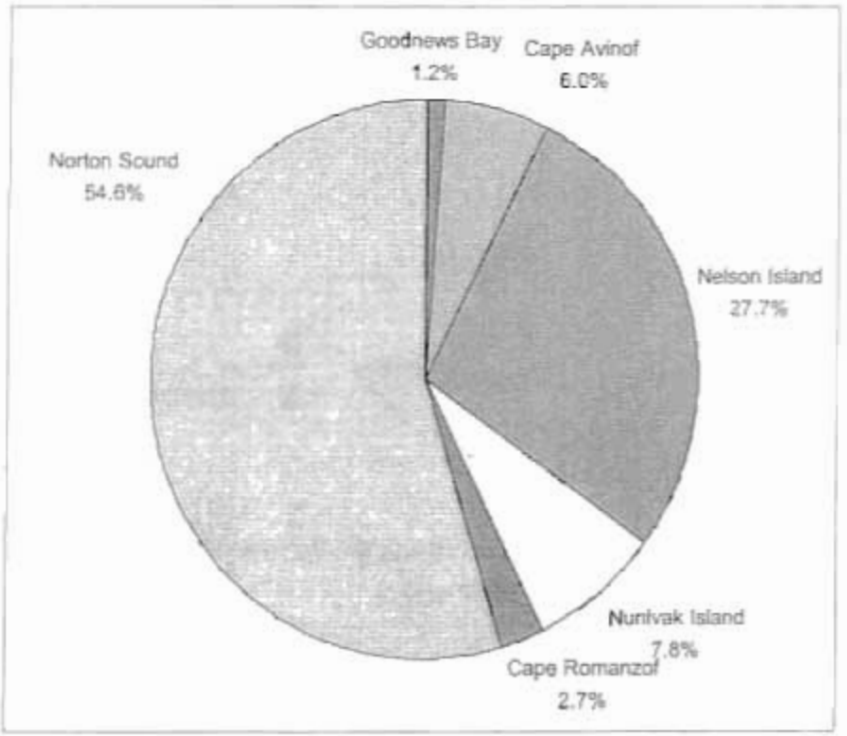

Figure 4. Pacific herring commercial harvest distribution by fishing district, Arctic-Yukon-Kuskokwim Region, Alaska, 2003.

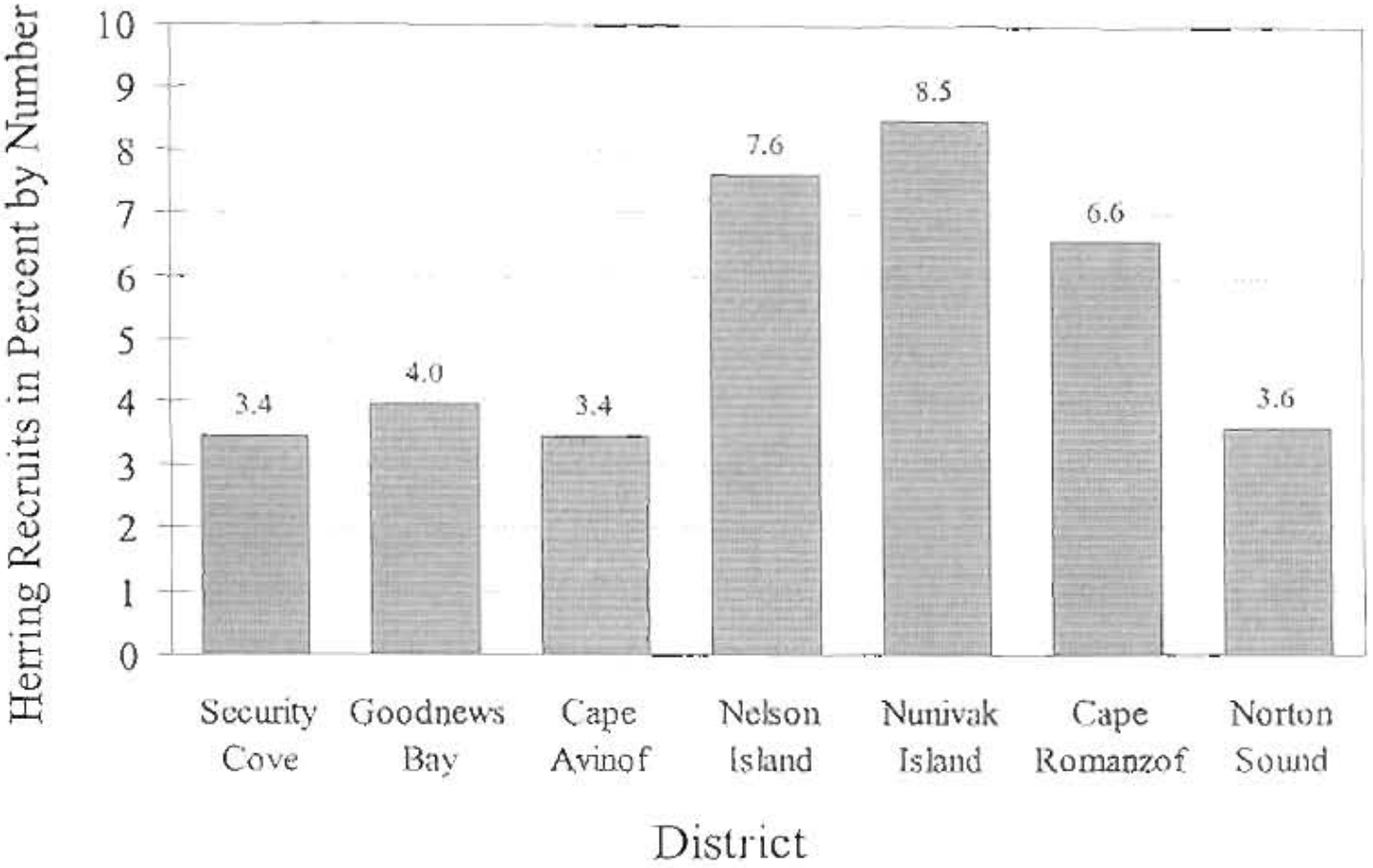

Figure 5. Pacific herring recruits (ages 2 through 5) for commercial fishing districts within the Arctic-Yukon-Kuskokwim Region, Alaska, 2003.

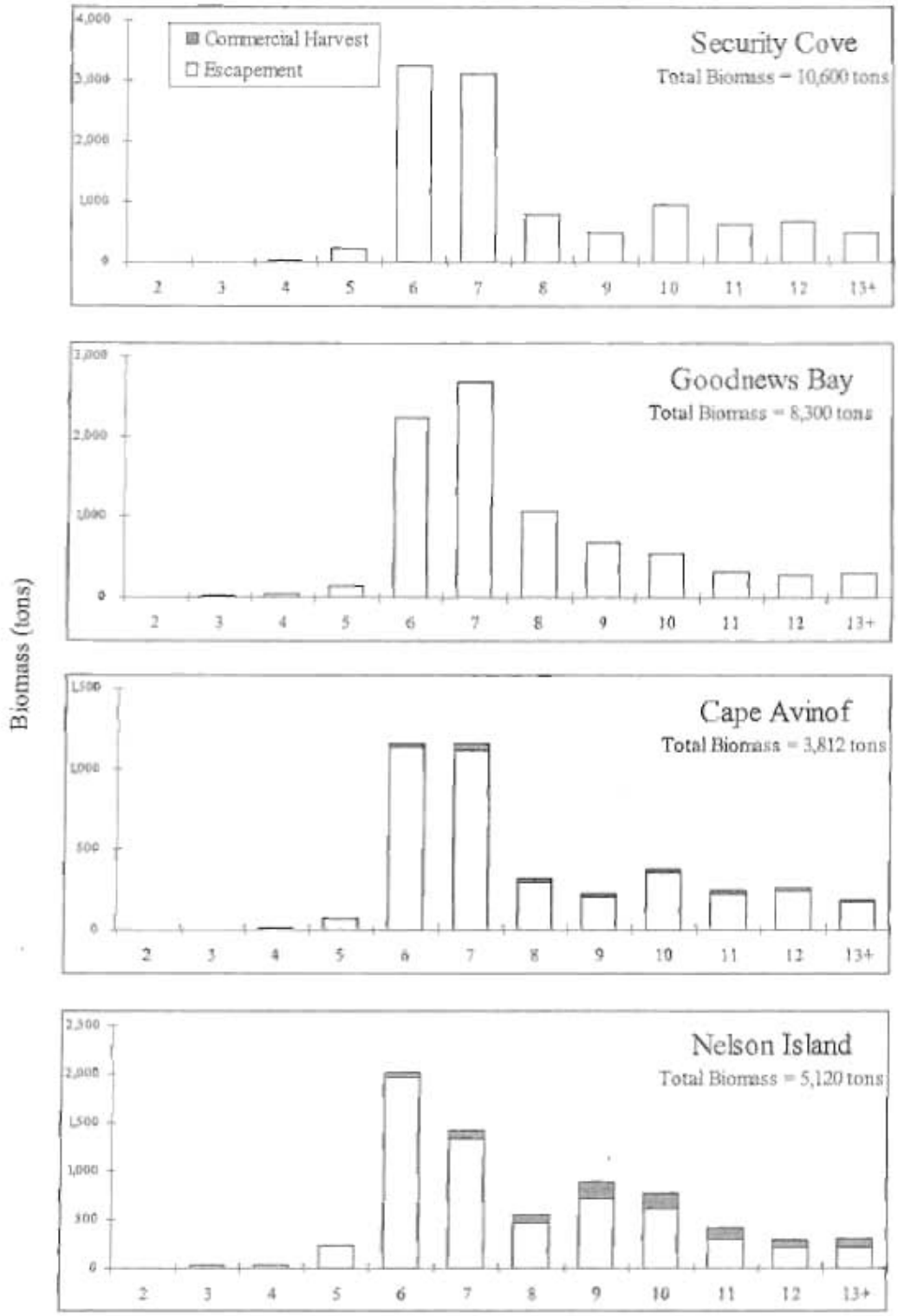

Figure 6. Age composition of Pacific herring for the total estimated biomass (escapement and havest) for the Security Cove, Goodnews Bay, Cape Avinof, and Nelson Island Districts within the Arctic-Yukon-Kuskokwim Region, Alaska, 2003.

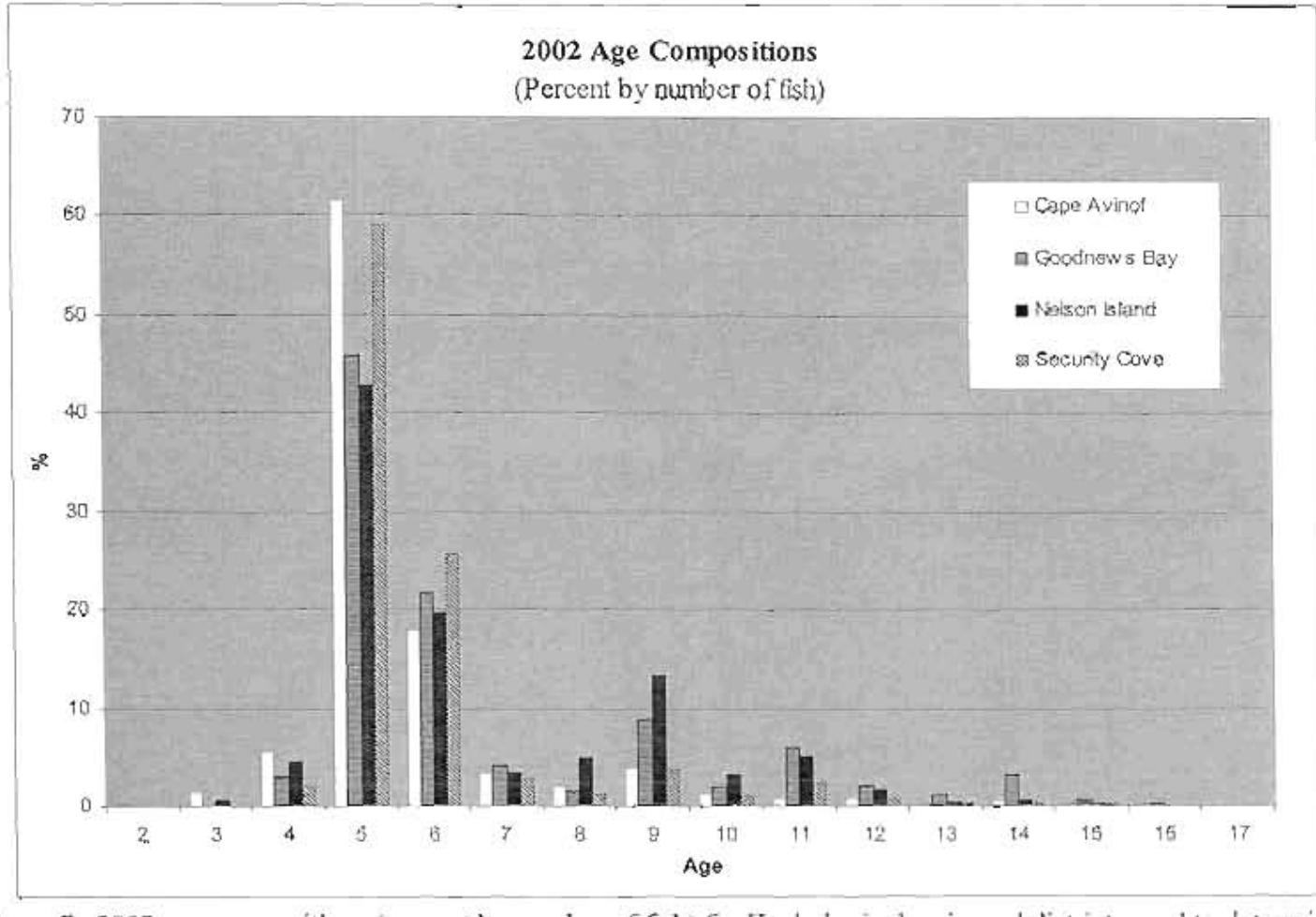

Figure 7. 2002 age compositions (percent by number of fish) for Kuskokwim herring subdistricts used to determine best fit for surrogate Cape Avinof VMG data.

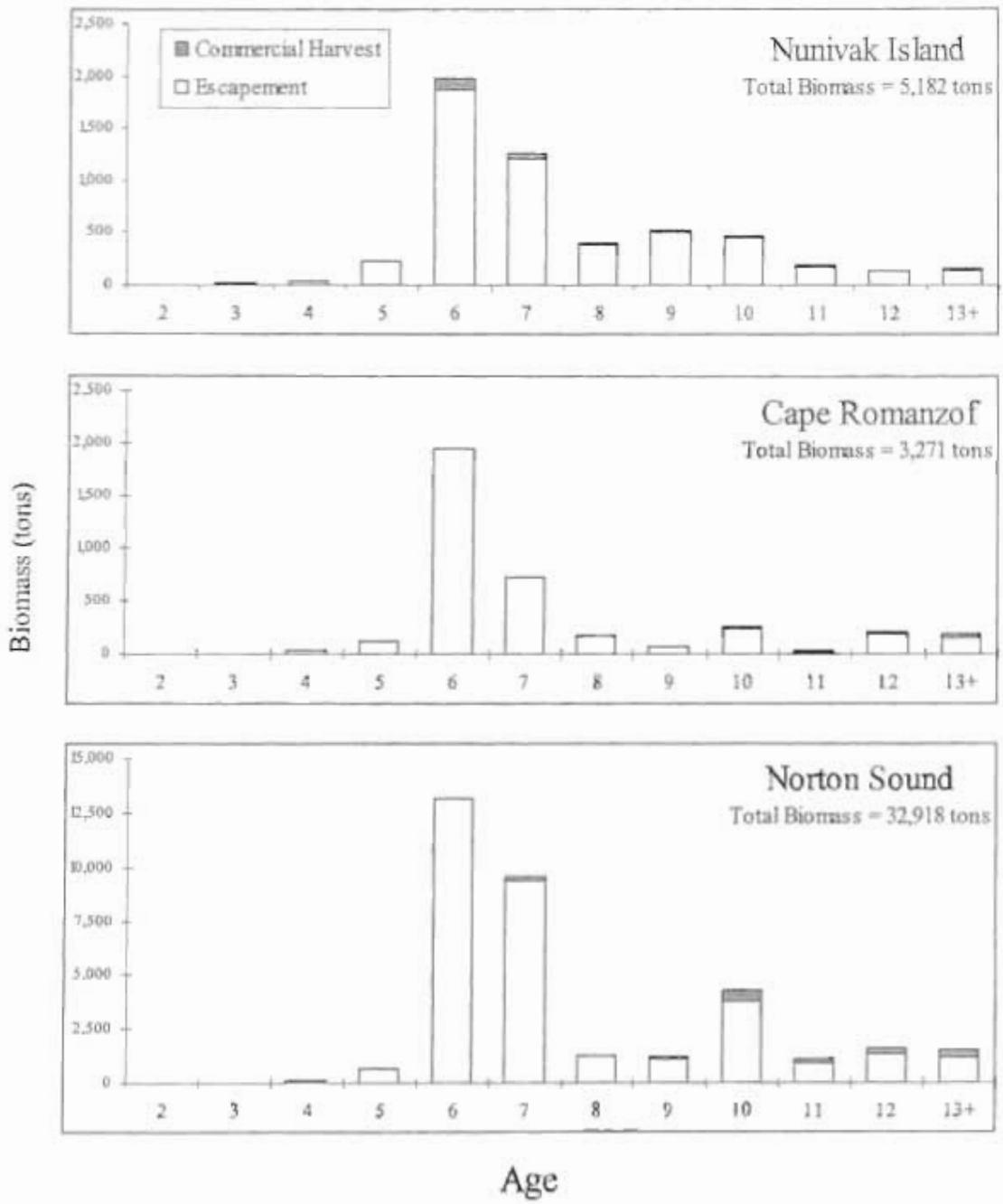

Figure 8. Age composition of Pacific herring for the total estimated biomass (escapement and harvest) for the Nunivak Island, Cape Romanzof, and Norton Sound Districts within the Arctic-Yukon-Kuskokwim Region, Alaska, 2003.